LDRD Proposal: Wireless Data and Power Transfer

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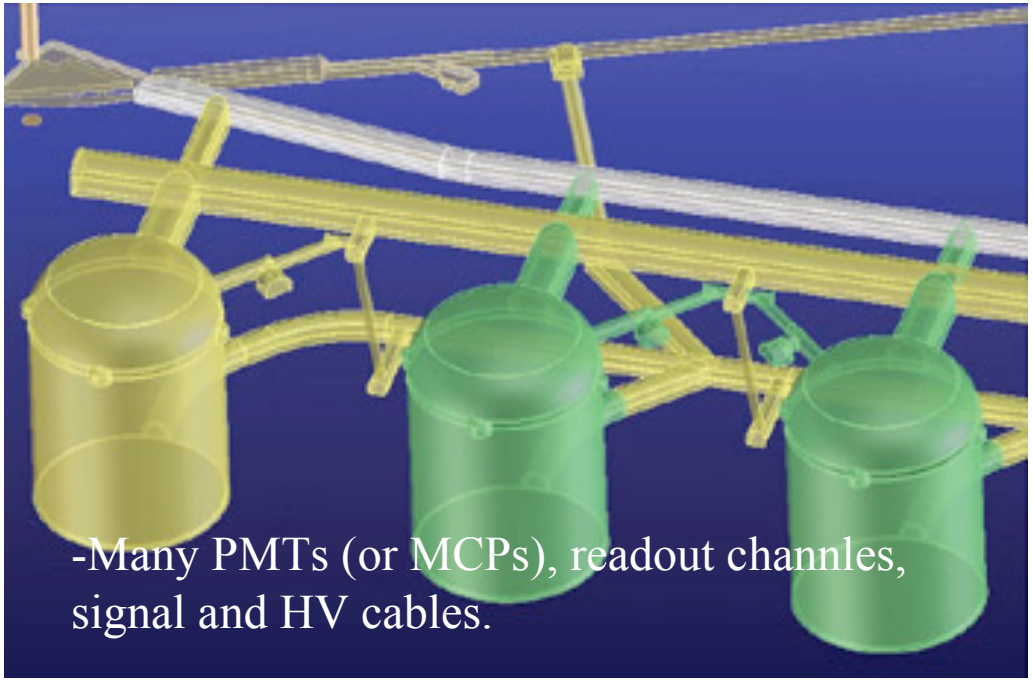
-With the detectors increasing in its size and/or being built in remote areas (no Lab infrastructure, electrification,..) it is complication to use traditional approach where the signal and the power are distributed with electric cables.
-Cabling may represent a significant cost and complication in experiments and leads to signal attenuation and deterioration.

-Example of basic science
i.e. neutrino physics
application: LBNE@DUSEL

-If the cables are used with Water Cerenkov detectors in Fig one would need 60000 x100 m of the cable length per detector

-Simpler applications: need to measure radioactivity, muon rates, or seismic activity in underground cavities before setting a lab or an underground waste storage facility, etc).

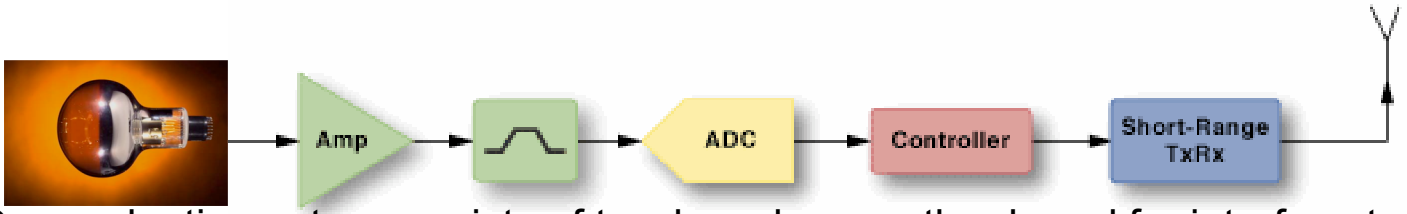


-Many PMTs (or MCPs), readout channles, signal and HV cables.

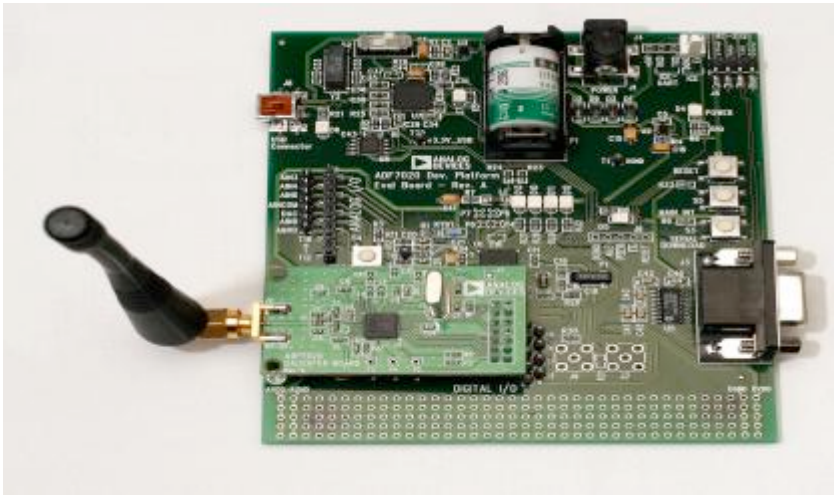
Proposal has two components, to be addressed separately:
-data transfer (RF technology)
-power transfer (optical beam)

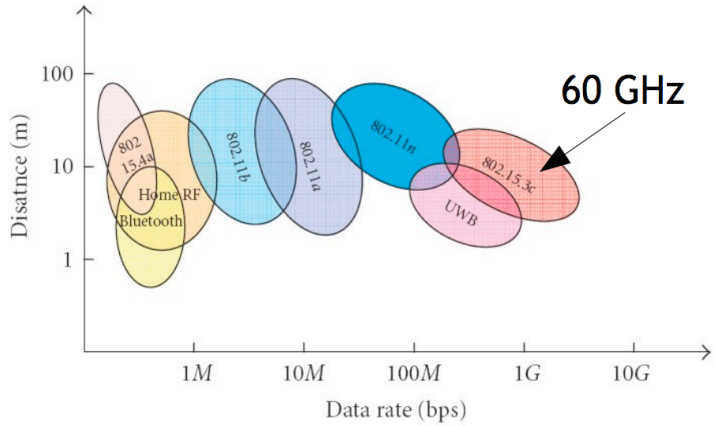
Data Transfer:

Idea is to develop a wireless data transfer application based on commercial RF cell-phone tech.
We would collect the data with a local receiver and then transmit it upwards.
We expect the data transfer to be less than 500 kbps per PMT channel.

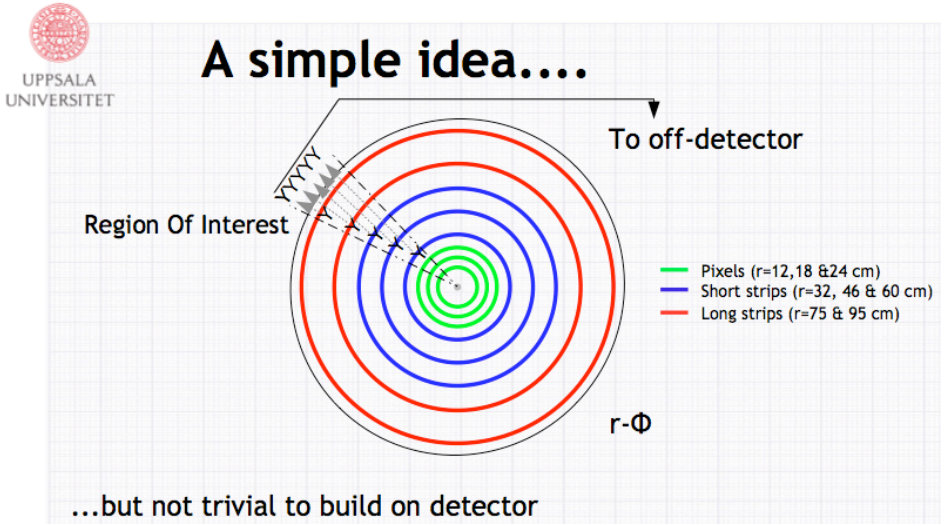


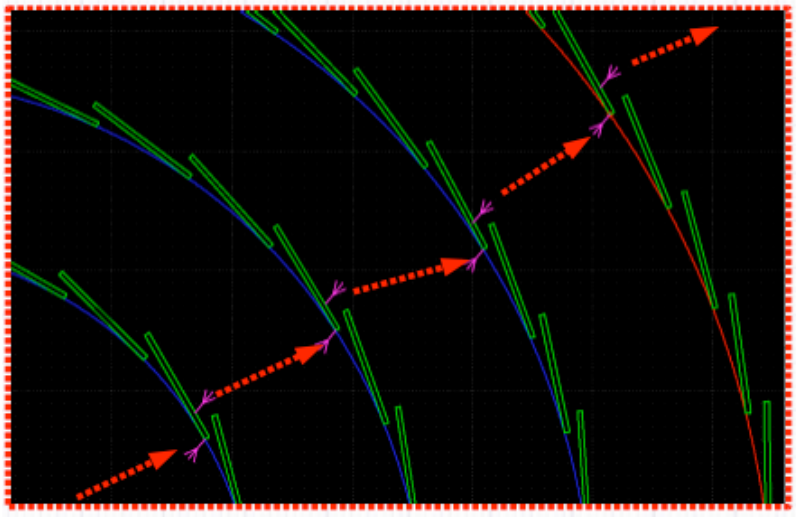
Our evaluation setup consists of two boards, a mother board for interface to PC, and a small form-factor radio module or daughter board with transmitting/receiving unit:





Who else is thinking about this? Collider Physics Community: want wireless transfer of L1 track trigger data in ATLAS ID





Another part of R&D would be to address the Power Transfer:

-Current idea is to adopt a low-voltage power supply to FEE board, and Cockroft-Walton bases to the PMTs. The Cockcroft-Walton base converts the low-voltage output from the board to the very high voltages needed to operate the PMTs (~1000 V). (We have experience with CW!)

-The low voltage power supply may be realized with a high-efficient lithium-ion battery that will be recharged by use of an optical wireless electricity system attached to it.

-The wireless electricity system uses optical transmitters and receivers to deliver power.

-Use Infra Red laser diodes to turn the electricity into optical, then detect with photodiodes.

-Similar to a solar cell, but higher efficiency.

-The method was recently demonstrated by Power Beam, Inc. (www.powerbeaminc.com)

The beneficiaries and customers of this project are the scientific communities, including HEP, homeland security, and others that use detection devices in remote areas without laboratory infrastructure will benefit from this work.

Backup Slides

Example of the future large ν project: LBNE (long baseline ν exp)

-Large size detectors (H_2O,LAr)
-Many PMTs (or MCPs), readout channles, signal and HV cables.